

Recent Trends in Cesarean Section Use in California

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Editor

Cesarean section use in the United States has increased to 24.7% of deliveries in 1988 and is the most common hospital surgical procedure. California cesarean section rates were examined to measure recent trends in obstetric practices and to project future patterns of cesarean section use. Using discharge abstracts from 1983 to 1987 California hospital deliveries, total cesarean section rates were found to increase from nearly 22% in 1983 to 25% in 1987, an increase of 15%. Using a series of least-squares regression models, time trends in the distribution of indications associated with cesarean section among all deliveries and indication-specific cesarean section rates were evaluated. Increases in the number of women with previous cesarean section and fetal distress contributed to rising cesarean section rates. In addition, indication-specific cesarean section rates increased for breech presentation and dystocia. These trends were counterbalanced, in part, by declining rates of repeat cesarean sections. Trends noted for July 1985 through 1987 did not differ substantially from those observed for January 1983 to June 1985, suggesting that recent policy attempts to alter cesarean section use have not had a measurable effect on existing trends. Projections suggest that California cesarean section rates will rise to a level of 34% by the year 2000.

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In the past 20 years cesarean section use has increased dramatically to become the most common surgical procedure in United States hospitals.¹ While in 1970 only 5.5% of US deliveries were by cesarean section, the 1988 cesarean section rate was 24.7%.² The National Center for Health Statistics has projected a cesarean section rate of 40% by the year 2000.³ Increases in cesarean section use have been accompanied by concerns regarding maternal and perinatal outcome and health care costs.⁴ Doubts regarding the appropriateness of current trends have led to persistent attempts to modify practice patterns.^{4,5} While the presumed failure of these strategies has been asserted,^{6,7} between 1986 and 1988 US cesarean section rates only increased from 24.1% to 24.7%.² A more detailed examination of this slowing rate of increase, however, suggests the potential for renewed increases in the future.

To fill the need for a current assessment of trends in cesarean section use, California cesarean section rates are examined using 1983 to 1987 hospital discharge abstract data. Past research indicates that cesarean sections are carried out for a heterogeneous set of clinical indications, including a previous cesarean section, breech presentation, dystocia, fetal distress, and other indications. In this report I analyze each of these indications through a series of regression models that measure time trends in the relative frequency of obstetric indications and indication-specific cesarean section rates. This process allows an evaluation of whether cesarean section rates are now rising more slowly and enables the projection of future patterns of obstetric practice.

Methods

Hospital Discharge Data

The Office of Statewide Health Planning and Development collects information on every nonmilitary hospital discharge in California.⁹ These data were available for 1983 through 1987 and include between 401,901 and 483,535 annual deliveries. The mode of delivery was determined by diagnosis-related group codes 370 through 371 (cesarean sections) and 372 through 375 (vaginal deliveries). Cesarean section rates were calculated as the number of cesarean sections per 100 deliveries. Diagnostic information was available as codes of the *International Classification of Diseases*, ninth revision (ICD-9-CM).¹⁰ To account for deliveries with more than one diagnosis, a widely employed hierarchy of mutually exclusive primary indications was adopted for this analysis.^{11,12} From highest to lowest priority, these were as follows: previous cesarean section (ICD-9-CM code 654.2), breech presentation (652.2 and 669.6), dystocia (653 and 660 to 662, except 661.3), fetal distress (656.3), all other indications (other codes in 642 to 663, and 669, except 669.1 to 669.5), and no reported indications. When more than one indication was present for a delivery, the highest priority diagnosis was assigned regardless of its order on the discharge abstract. For example, those deliveries defined as a breech presentation exclude cases of breech presentation occurring in women with previous cesarean sections. The small number of cesarean sections without a reported indication (461 deliveries in 1987) are included in the actual and projected total cesarean section rates but are not displayed separately.

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Statistical Methods

Time trends in yearly and monthly cesarean section rates were determined according to the date of admission. Patterns of cesarean section use were dissected into two components: the relative frequency of indications often associated with cesarean section (how frequently a condition occurs among all deliveries), and indication-specific cesarean section rates (the rate of cesarean section given the occurrence of a condition).¹² For greater precision in analyzing time trends, separate statistical analyses were done for these two components. This allowed the analysis to account for the distinct trends in cesarean section use present for different clinical indications.

To measure the statistical significance of trends in cesarean section use, a series of regression models was developed on an indication-specific basis. The month was used as the independent variable to predict the relative frequency of indications associated with cesarean section and indication-specific cesarean section rates. Because both relative frequency and cesarean rates must take values between 0% and 100%, it was necessary to algebraically transform these figures so that future projections would fall within this range. Rates and frequencies were transformed into logits for the regression, so that, for example:

$$\log_e \{ [P(CS)] / [1 - P(CS)] \} = b_0 + b_1 \cdot \text{month},$$

where $P(CS)$ is the indication-specific probability of cesarean section. A positive coefficient indicates an increasing cesarean rate (or relative frequency), and a negative coefficient indicates a decreasing cesarean rate (or relative frequency). A weighted least-squares method was used to estimate the regression equations.¹³

Three sets of regression equations were estimated: 30 months of data from January 1983 to June 1985, 30 months of data from July 1985 to December 1987, and 60 months of data from 1983 through 1987. The estimated annual percentage change in the cesarean section rate (or relative frequency) was calculated from each regression equation at the midpoint of the time period covered by the equation. These figures were compared to assess whether the more recent 1985 to 1987 trends differed from those for the earlier 1983 to 1985 period. Because the obstetric indications were defined in a mutually exclusive and hierarchic manner, regression models for the relative frequency of indications

used denominators that excluded deliveries in higher priority categories. For example, in the regression models the relative frequency of breech presentation was calculated for deliveries other than those with a previous cesarean section.

Future patterns of cesarean section use through 2000 were estimated by extrapolating from the indication-specific regression equations based on the entire 1983 to 1987 data (60 months). Although there is a great deal of statistical uncertainty associated with these projections, they provide a useful estimate of where current practice patterns may be leading. The total cesarean section rate for 2000 was projected by aggregating by individual indications associated with cesarean section.

Results

The total cesarean section rate in California increased from 21.7% in 1983 to 25.0% in 1987, an increase of 15.2%. Monthly rates ranged from 20.9% in January 1983 to 25.4% in June 1987. Consistent with national estimates,² the increase in total cesarean section rates from 24.5% in 1986 to 25.0% in 1987 was smaller than in preceding years. Time trends in the proportion of deliveries with a particular indication and indication-specific cesarean section rates varied by indication. Although cesarean section rates increased for most indications, declining indication-specific rates were noted for women with previous cesarean sections. Trends noted for 1985 to 1987 did not differ greatly from those observed for 1983 to 1985. Projections by the specific indications associated with cesarean section suggest that by 2000 the cesarean section rate in California will rise to 33.7%.

Previous Cesarean Section

The occurrence of deliveries to women with previous cesarean sections increased from 8.6% of all deliveries in 1983 to 10.2% in 1987 (Table 1). Monthly increases in the relative frequency of previous cesarean sections were similar for 1985 to 1987 compared with 1983 to 1985. Cesarean section rates in women with previous cesarean sections, however, decreased between 1983 and 1987 (Table 2). In 1983, 93.0% of women with previous cesarean sections were delivered by another cesarean section, but by 1987, the repeat cesarean section rate was 87.4%. Monthly time trends in repeat cesarean section rates were statistically

TABLE 1.—Relative Frequency of Obstetric Indications Among All Hospital Deliveries, California, 1983 to 1987

Year	Number of Deliveries	Deliveries With a Specific Indication/100 Total Deliveries						Total
		Previous Cesarean Section	Breech Presentation	Dystocia	Fetal Distress	Other Indications	No Indications	
1983.....	401,901	8.6	3.1	11.1	5.7	21.2	50.3	100.0
1984.....	405,927	9.1	3.1	11.4	6.9	22.4	47.1	100.0
1985.....	444,908	9.2	3.1	11.7	8.0	23.3	44.7	100.0
1986.....	461,569	9.9	3.0	12.2	8.5	24.0	42.4	100.0
1987.....	483,535	10.2	3.1	12.5	8.2	24.8	41.3	100.0
Projected 2000*		18	3	17	22	26	14	100
Regression 1983 to 1985†								
Annual percentage change, %.....		5.1	0.0	3.3	21.0	8.6		
(95% confidence limits).....		(3.4, 6.9)	(-1.3, 1.4)	(2.3, 4.3)	(19, 23)	(7.5, 9.6)		
Regression 1985 to 1987‡								
Annual percentage change, %.....		5.3	2.1	3.8	0.4	4.3		
(95% confidence limits).....		(4.0, 6.7)	(0.8, 3.4)	(2.7, 4.9)	(-2.4, 3.2)	(3.5, 5.1)		

*Projected proportions of each indication as a proportion of all deliveries are derived from regression equations based on 1983 to 1987 data.

†Based on regression equations in the form of $\log_e [\text{proportion}/(1-\text{proportion})] = b_0 + b_1 \cdot \text{month}$, for 30 months from January 1983 to June 1985.

‡Based on regression equations in the form of $\log_e [\text{proportion}/(1-\text{proportion})] = b_0 + b_1 \cdot \text{month}$, for 30 months from July 1985 to December 1987.

TABLE 2.—Cesarean Section Rates by Indication, Hospital Deliveries, California, 1983 to 1987

Year	Cesarean Sections/100 Deliveries With a Specific Indication					Total
	Previous Cesarean Section	Breech Presentation	Dystocia	Fetal Distress	Other Indications	
1983	93.0	81.9	62.2	30.2	11.8	21.7
1984	91.4	82.6	62.3	28.9	11.3	22.6
1985	89.9	85.6	62.8	27.8	11.6	23.2
1986	89.2	86.9	64.4	28.5	11.5	24.5
1987	87.4	87.0	63.8	30.6	11.5	25.0
Projected 2000*	50	96	70	32	11	34
Regression 1983 to 1985						
Annual percentage change, %†	-1.6	1.9	0.1	-4.6	-1.9	
(95% confidence limits)	(-2.0, -1.2)	(1.0, 2.7)	(-0.7, 0.7)	(-6.7, -2.4)	(-3.7, -0.2)	
Regression 1985 to 1987						
Annual percentage change, %‡	-1.4	0.7	0.1	6.9	-1.1	
(95% confidence limits)	(-1.9, -0.9)	(0.1, 1.3)	(-0.6, 0.8)	(4.0, 10.0)	(-2.6, 0.3)	

*Projected indication-specific cesarean section rates are derived from regression equations based on 1983 to 1987 data.

†Based on regression equations in the form of $\log_e [\text{rate}/(1-\text{rate})] = b_0 + b_1 \cdot \text{month}$, for 30 months from January 1983 to June 1985.

‡Based on regression equations in the form of $\log_e [\text{rate}/(1-\text{rate})] = b_0 + b_1 \cdot \text{month}$, for 30 months from July 1985 to December 1987.

significant and similar for 1983 to 1985 compared with the more rapid declines for 1983 to 1985.

Breech Presentation

Between 1983 and 1987, the occurrence of breech presentation remained close to 3.1% of deliveries (Table 1). The rates of cesarean section for breech presentation increased from 81.9% in 1983 to 87.0% in 1987 (Table 2). A regression analysis of monthly trends indicated that increases in cesarean section rates for breech presentation between 1985 and 1987 were slower than those from 1983 to 1985.

Dystocia

Because dystocia is a subjective diagnosis, the reported frequency of dystocia is itself an important indicator of practice patterns.⁴ Between 1983 and 1987, the occurrence of dystocia increased from 11.1% to 12.5% (Table 1). The most recent trends (1985 to 1987) were not significantly different from the trends for 1983 to 1985.

Statistically significant increases in cesarean section rates for dystocia were observed from 1983 (62.2%) to 1987 (63.8%), although trends within each 30-month period were not statistically significant (Table 2). In addition, no differences in trends for 1985 to 1987 and 1983 to 1985 were noted. The increases in both the occurrence of dystocia and dystocia-specific cesarean section rates show that this indication has made a sizable contribution to increases in the total cesarean section rate between 1983 and 1987.

Fetal Distress

The relative frequency of fetal distress increased from 5.7% of all deliveries in 1983 to 8.2% in 1987, although the regression analysis indicates that there has been a slowing of this increase in 1985 to 1987 compared with 1983 to 1985 (Table 1). Cesarean section rates for fetal distress decreased from 30.2% in 1983 to 27.8% in 1985, then increased to 30.6% by 1987 (Table 2). Like dystocia, fetal distress is a subjective diagnosis.⁴ Fluctuating cesarean section rates for fetal distress combined with the more frequent reporting of fetal distress suggest that this indication also has contributed to rising total cesarean section rates.

Other Indications

The occurrence of other indications associated with cesarean section has increased from 21.2% in 1983 to 24.8%

in 1987 (Table 1). Based on the regression analysis, the magnitude of this increase was less dramatic for 1985 to 1987 compared with 1983 to 1985. Cesarean section rates in the presence of other indications have remained approximately constant (Table 2).

Projection of Future Cesarean Section Rates

Based on the trends for the entire 1983 to 1987 period, statistical projections suggest that future cesarean section rates will continue to increase, reaching a rate of 34% by the year 2000 (Figure 1, Table 2). This figure represents the aggregation of individual projections of relative frequency of indications and indication-specific cesarean section rates (Tables 1 and 2). The projected rate of increase from 1987 to 2000 is considerably slower than observed during the 1983 to 1987 period, largely because of projected decreases in repeat cesarean section rates.

Discussion

Between 1983 and 1987, cesarean section rates in California increased from 21.7% to 25.0%, representing the continuation of previously noted trends.^{2,7,12} These results are of particular interest given the widespread dissemination of research questioning the clinical rationale for increasing cesarean section use.¹⁴ When the data of the 30 months from July 1985 to December 1987 are compared with those of the 30 months from January 1983 to June

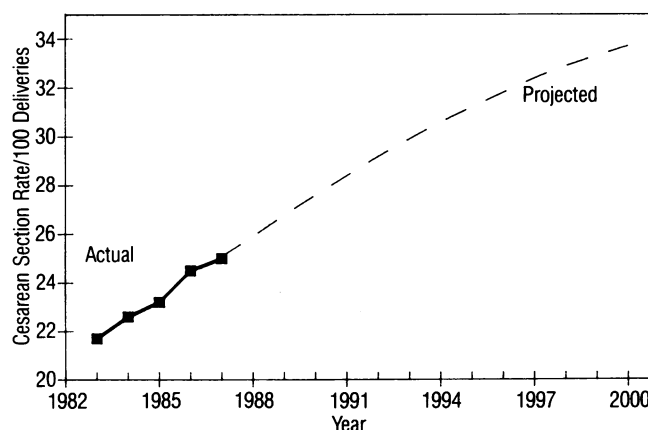


Figure 1.—Actual (1983 to 1987) and projected (1988 to 2000) total cesarean section rates are shown per 100 California hospital deliveries. Projected rates are based on indication-specific regression analysis of 1983 to 1987 data.

1985, there is no convincing evidence that the most recent trends deviate from earlier trends. The increasing prominence of health policy strategies attempting to alter cesarean section use has not had a dramatic effect on these recent trends.

Projecting future practice patterns suggests that total cesarean section rates will increase less rapidly than in the past. This slowing rate of increase is due to decreasing repeat cesarean section rates, which will become increasingly important as the number of women with previous cesarean sections increases. In addition, there are mathematic limits on the extent to which the relative frequency of indications associated with cesarean section can increase. Currently just under 50% of deliveries have an indication associated with cesarean section.

The projected total cesarean section rate of 34% in 2000 is considerably lower than the projection of 40% made by the National Center for Health Statistics.³ The lower rate projected in this study results from its more detailed analysis of specific indications associated with cesarean section and illustrates the limitations of emphasizing aggregate linear trends. The projections made in this report have taken into account the finding that trends in cesarean section use vary with different clinical indications.

The close parallel between California and national trends¹⁵ makes it likely that these results approximate patterns for the nation as a whole. The large number of deliveries in California (13% of all 1987 deliveries in the US) allows for the reliable estimation of current obstetric practice patterns, but the use of hospital discharge abstracts to monitor and project obstetric practice patterns is not without its limitations. Although the data are relatively recent, the use of data through 1987 does not reflect changes in cesarean section use that may have occurred in the past three years. In addition, the uniformity and reliability of the reporting of indications associated with cesarean section may be less than optimal. The increased reporting of fetal distress and dystocia, for example, is likely to reflect the subjective nature of diagnosing these conditions rather than objective changes in the obstetric population.⁴ Although the projections are based on only five years of data, the trends during 1983 to 1987 are consistent with earlier patterns of increasing cesarean rates.¹⁵

The methods used to project future patterns of cesarean section use assume that the 1983 to 1987 trends will continue unchanged into the future. Therefore, this study's projections do not account for recent or future policy strategies aimed at reducing cesarean section use.⁵ Given the likelihood of some success in affecting practice patterns through educational, utilization review, and reimbursement-oriented strategies, these forecasts ultimately may overestimate future cesarean section rates.

The observed trends in obstetric practice patterns are unlikely to have been uniform across individual physicians

or hospitals. Cross-sectional data suggest that cesarean section rates vary considerably on the basis of nonclinical patient and organizational factors.¹⁶⁻¹⁸ By extension, different settings of hospital care may have experienced different time trends in cesarean section use. Past research, for example, indicates smaller increases in the cesarean section rate for teaching hospitals than in other settings.¹⁹

The projection of a 34% cesarean section rate by the year 2000 has substantial policy implications. Hospital and physician charges for cesarean sections (\$5,300) are 83% higher than charges for vaginal deliveries (\$2,900).^{20,21} Therefore, the 36% increase in cesarean section rates projected for 1987 to 2000 will alone raise the cost of obstetric care by 6%. The magnitude of this projected increase should give further impetus to strategies aimed at reducing cesarean section use.

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